

R E M A R K S

The specification was amended to correct minor clerical errors.

The amendments to claims 1, 5 and 11 are supported in the specification on page 5, lines 11 to 13 (also see original claims 9, 10, 12 and 13); page 11, lines 11 to 14; page 12, lines 11 to 13; and page 49, lines 5 to 9 and 11 to 16.

Claims 2, 4 and 26 to 29 were editorially revised.

Claims 9, 10, 12 and 13 were amended to a single recited feature, namely chromium or an alloy of chromium.

With respect of Rule 116, entry of the amendments is respectfully requested, since some of the amendments serve to reply to an objection and a 35 USC 112 rejection set forth in the final rejection. Moreover, it is respectfully submitted that the amendments serve to better clarify and define applicants' invention.

The Information Disclosure Statement dated August 13, 2003 identified the following publication: "World of Plating," Vol.

23, No. 4, April 1990, Plating Association of Tokyo, p. 38, col. 1, line 24 - col. 5, line 25. An English-language translation of said publication was attached to the August 13, 2003 Information Disclosure Statement. In view of the amended claims presented herein, the Examiner's attention is directed to the aforesaid "World of Plating" publication.

Claims 3 and 26 were objected to for the reasons set forth beginning at the middle of page 2 of the November 8, 2005 Office Action.

Claims 3 and 26 were amended to avoid the objection.

For the reasons set forth beginning at the bottom of page 2 and continuing to the middle of page 3 of the November 8, 2005 Office Action, claims 8 to 10 were rejected under 35 USC 112, first paragraph, as failing to comply with the written description requirement.

Claim 8 was amended to avoid the 35 USC 112 rejection.

It is respectfully submitted that the present claims comply with all the requirements of 35 USC 112.

Claims 1, 2, 4 to 9, 11, 12, 14, 24, 25 and 27 to 29 were rejected as being anticipated by Wheatley (USP 3,915,809) for the reasons set forth on pages 3 to 5 of the November 8, 2005 Office Action.

Claim 3 was rejected as being unpatentable over Wheatley in view of Stareck (USP 2,250,556) for the reasons stated on page 6 of the November 8, 2005 Office Action.

It was admitted in the November 8, 2005 Office Action that Wheatley does not specify that the cathode electrolysis step would be carried out with an alkaline reduction treatment solution including sodium chloride.

Claim 26 was rejected as being unpatentable over Wheatley in view of Stareck, and further in view of Westbrook (USP 2,931,760). The reasons for this rejection begin at the bottom of page 6 and extend to page 7 of the November 8, 2005 Office Action.

It was admitted in the November 8, 2005 Office Action that Wheatley in view of Stareck does not specify that the halide salt would be potassium chloride.

Claims 10 and 13 were rejected as being unpatentable over Wheatley further in view of Hidaka et al. (USP 5,425,822) for the reasons indicated at the middle of page 7 of the November 8, 2005 Office Action.

It was admitted in the November 8, 2005 Office Action that Wheatley does not specify forming a chromium alloy layer.

USP 3,915,809 to Wheatley relates to metal plating of plastics, and more particularly to an improved method of metal plating transparent acrylic plastic materials such as polymethyl methacrylate.

In USP 3,915,809, a surface of a polymethyl methacrylate plastic substrate is sanded, washed with water, dipped in methanol for about 10 seconds, and then rinsed with water. Next, the surface of the plastic substrate is activated in the normal manner, e.g., by dipping the substrate in an aqueous solution containing 159g/L stannous chloride for about 4 minutes, then immersing the substrate in an aqueous solution containing 7.5/L palladium chloride for about 4 minutes, and then immersing the plastic substrate for about 10 minutes in an aqueous electroless

copper solution of the following composition: $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (15g/L)/ $\text{Na}_2\text{C}_4\text{H}_4\text{O}_6 \cdot 2\text{H}_2\text{O}$ (30g/L)/NaOH (14g/L)/pH=13.2/formaldehyde (10ml/L). Next, the electroless copper deposit is electroplated with successive blanket layers of copper, nickel and chromium in the usual way for depositing such metals.

In Wheatley, the electrodeposited blanket layer of copper is deposited at room temperature from an aqueous solution. A 25 μm thick layer of copper is electrodeposited at a current density of 4.3 amperes per square decimeter, which takes about 30 minutes, to electroplate with nickel. A 12.7 μm thick blanket nickel layer is deposited onto the copper layer by electrodeposition for about 15 minutes at a current density of about 4.7 amperes per square decimeter at a temperature of about 60°C in an aqueous solution.

After the nickel plating in Wheatley, the substrate is immersed in a chromium plating bath, and a blanket coating of chromium, 0.000025 mm (250Å) thick, is deposited at a current density of about 23 amperes per square decimeter for about 3 minutes at a temperature of about 41°C. A photosensitive coating,

a resist, is then applied to the chromium plated surface, exposed and developed to form an etch resist mask on the surface of the plated surface.

The substrate in Wheatley is then immersed for about 2 minutes in an aqueous solution at room temperature containing 50 volume percent concentrated hydrochloric acid. This etches away the exposed portion of the chromium layer which was not covered by the resist. The masked substrate is spray etched for about 4 minutes at room temperature with a 42° Baume ferric chloride solution, and the resist is removed.

Wheatley does not result in any adverse effects with respect to the clarity and transparency of the plastic substrate exposed on the transparent plastic substrate such as polymethyl methacrylate, and sufficient adhesive strength with the plastic substrate can be provided. Thus, it is clear that USP 3,915,809 is a plating method for an easy and inexpensive production.

In contrast to Wheatley, applicants' present claims relate to a chemical treatment method by which a metal film formed on a substrate is etched into a predetermined pattern.

The object of applicants' present claims is to form a fine electric wiring on a plastic substrate by a metal which is a conductive substance. For example, an alloy containing a metal such as Cr is formed on the surface of a plastic substrate by a dry method such as sputtering to increase the adhesive strength, and successively, a metal, such as a copper film, is formed on the Cr alloy (or Cr film). Then, the copper is deposited by a well-known copper plating method. An etching resist is then applied to the plated surface, and exposed and developed using a predetermined mask to form a predetermined pattern, and the copper is etched by using a copper etching solution. The surface of the plastic substrate is covered by the etching resist and the exposed metal, e.g., Cr. A passivated film is formed on the surface of the exposed metal, e.g., Cr. The entire passivated film or a portion of the passivated film is immersed in a reaction treatment solution and a cathode electrolysis reduction is carried out for a predetermined time, thereby producing nascent hydrogen. The passivated film is reduced to a chromium metal by the nascent hydrogen. Then, wet etching is carried out

by immersing the substrate in an etching solution, e.g., about 0.7 volume percent of diluted hydrochloric acid solution when converted to a concentration of concentrated hydrochloric acid, to prevent production of hexavalent chromium.

Therefore, applicants' present claims are substantially different from Wheatley which "relates to metal plating plastics, and more particularly to an improved method of metal plating transparent acrylic plastic materials such as polymethyl methacrylate" (column 1, lines 6 to 9 of Wheatley). Please refer to the enclosed Attachment 1.

In the November 8, 2005 Office Action, it was stated that, regarding claim 1, Wheatley teaches a cathode reduction step (col. 2, lines 40-49; col. 2, lines 57-69; col.3, lines 3-13 or col. 3, lines 15-26).

Column 2, lines 40 to 49 in Wheatley referred to in the Office Action disclose merely depositing copper by an electroless plating method using a reduction reaction for reducing a publicly known copper ion to a copper metal.

Column 2, lines 57 to 69 in Wheatley referred to in the Office Action discloses merely depositing copper by an electroplating method using a well-known reduction reaction for reducing copper ion to a copper metal.

Column 3, lines 3 to 13 in Wheatley referred to in the Office Action disclose merely depositing nickel by an electroplating method using a reduction reaction for reducing a publicly known nickel ion to a nickel metal.

Column 3, lines 15 to 26 in Wheatley referred to in the Office Action discloses merely depositing chromium by an electroplating method using a reduction reaction for reducing a publicly known chromium ion to a chromium metal.

Accordingly, all the reduction reactions in Wheatley referred to in the Office Action are only for carrying out plating, namely, reducing metal ions to metal by electrons. It is respectfully submitted that it would be clear to one of ordinary skill in the art that Wheatley is completely different from and does not have any relevance to the reduction reaction in

applicants' present claims for reducing a passivated film with nascent hydrogen (please refer to the enclosed Attachment 2).

The position was taken in the November 8, 2005 Office Action that the "chemical treatment method of the present application" is taught by Wheatley. Applicants respectfully disagree.

The following is stated in the Office Action of November 8, 2005:

"Regarding claim 1, Wheatley teaches (col. 2, line 20 to col. 3, line 47) a chemical treatment method by which a metal film (col. 2, line 53) formed on a material to be subjected to film formation is etched (col. 3, lines 39-41) into a predetermined pattern, comprising: a cathode electrolysis reduction step comprising performing electrolysis reduction (col. 2, lines 40-49 or col. 2, lines 57-69 or col. 3, lines 3-13 or col. 3, lines 15-26) on a metal film as a cathode by using one of an acidic reduction treatment solution (col. 2, lines 62-65 or col. 3, lines 9-13 or col. 3, lines 20-21) containing an acid radical; and an etching step (col. 3, lines 34-38 or col. 3, lines 39-42) comprising etching the metal film in an etching treatment solution after the cathode electrolysis reduction step".

However, col. 3, lines 34-39 of Wheatley disclose only immersing a substrate in an aqueous solution containing 50 volume percent concentrated hydrochloric acid to selectively etch the substrate. Thus, it is clear that Wheatley does not teach or suggest the chemical treatment method recited in applicants' present claims (please refer to the enclosed Attachment 1).

The Examiner denied novelty of applicants' claims directed to immersing the entire passivated film of a material 100 to be treated as shown in Fig. 3A, or a portion of the passivated film as shown in Fig. 3B in a treatment solution, carry out a cathode electrolysis reduction for a predetermined time, whereby a passivated film is reduced to a chromium metal by nascent hydrogen, and carry out etching by immersing the substrate in an etching solution, e.g., about 0.7 volume percent of diluted hydrochloric acid solution when converted to a concentration of concentrated hydrochloric acid, on the basis that when forming a multi-layer metal film of Cu/Cu/Ni/Cr on a transparent plastic substrate by a plating method, a cathode reduction reaction which is publicly known in the technical field

of electroplating is carried out, and in the next independent step which is Cr etching, the substrate is immersed in a 50 volume percent concentrated hydrochloric acid solution to be etched.

However, Wheatley does not disclose or suggest that a "reduction reaction" is essential for "Cr etching." Moreover, applicants' present claims which are directed to a method for carrying out a cathode electrolysis reduction on a passivated film to reduce a metal using nascent hydrogen, and immersing a substrate containing the reduced metal in an etching solution to carry out etching, are substantially different from Wheatley.

The following was stated in the Office Action:

"Regarding claim 11, Wheatley teaches (col. 2, line 20 to col. 3, line 47) a chemical treatment method by which a metal film formed on a material to be subjected to film formation is etched into a predetermined pattern, comprising dipping a metal film in an acidic treatment solution containing a halogen ion (col. 2, lines 62-65 or col. 3, lines 10-14 or col. 3, lines 34-38 or col. 3, lines 40-42), and performing electrolysis reduction (col. 2, lines 40-49 or col. 2, lines 57-69 or col. 3, lines 3-13 or col. 3, lines 15-26) on the metal film as a cathode".

In conjunction with the above contention, it was stated in the Office Action that "dipping a metal film in an acidic treatment solution containing a halogen ion" of the present invention is publicly known.

However, col. 2, lines 62-65 of Wheatley referred to in the Office Action discloses a composition of a copper sulfate plating solution which is publicly known. Indeed, it is indicated that halogen is included. It is clear that the copper sulfate plating solution of col. 2, lines 62-65 of Wheatley contains the metal to be deposited, that is, copper ions. Wheatley discloses only that the main purposes for including halogen in the plating solution are: (1) to make the electrical conductivity of the plating solution favorable; and (2) to make dissolving of an anode (copper in a case of copper plating).

Col. 3, lines 10-14 of Wheatley referred to in the Office Action discloses a composition of a nickel electrolysis plating solution which is publicly known. It is clear that the nickel plating solution of col. 3, lines 10-14 of Wheatley contains the metal to be deposited, that is, nickel ions.

Col. 3, lines 34-38 of Wheatley referred to in the Office Action disclose immersing the substrate in hydrochloric acid to etch chromium.

Wheatley does not teach or suggest carrying out reduction for a predetermined time on a passivated film of chromium using nascent hydrogen to reduce the passivated film to a chromium metal and to etch chromium as in applicants' present claims.

Col. 3, lines 40-42 of Wheatley referred to in the Office Action discloses that a masked substrate is rinsed, and spray etched for about 4 minutes at room temperature with a 42° Baume ferric chloride solution. Wheatley discloses merely forming a multi-layer metal film of Cu (electroless)/Cu (electrolysis)/Ni (electrolysis) of the above etching method.

Column 3, lines 34-39 of Wheatley disclose an etching method of chromium. Wheatley discloses that the substrate is immersed in a room temperature aqueous solution containing 50 volume percent concentrated hydrochloric acid, and selectively etches away exposed portions of the chromium film. This is clearly different from applicants' present claims.

As clearly described in the First Chemical Treatment Method of the "DETAILED DESCRIPTION OF THE INVENTION" on page 13, line 2 through page 13, line 12 of the present specification and as indicated in Figs. 3A-3C, applicants' present claim 1 is for etching a predetermined pattern on a film (such as a chromium film) by immersing an entire passivated metal film of a material 100 to be treated as shown in Fig. 3A, or a portion of the passivated chromium film to a chromium metal by nascent hydrogen, and carrying out etching by immersing the substrate in an etching solution, e.g., about 0.7 volume percent of diluted hydrochloric acid solution when converted to a concentration of concentrated hydrochloric acid for a predetermined time. As described on page 13, line 23 through page 14, line 4 of the present specification, a chromium film 120 can be stably and uniformly etched into a predetermined pattern by carrying out a cathode electrolysis reduction process and an acid dip process in this order, without producing hexavalent chromium.

Attention is directed to "Experiment 1" of the present specification and Fig. 13. In EXPERIMENT No. 3 of Fig. 13, although the substrate was immersed in a 50-100 volume percent (about 7 to 14 volume percent of diluted hydrochloric acid when converted to a concentration of concentrated hydrochloric acid) of an acidic treatment solution at a temperature of 30-50°C for 30 seconds, the chromium film 120 could not be etched. In Experiment 1, the only condition under which the chromium film could be etched was EXPERIMENT No. 7 (see Fig. 13). It is clear from Fig. 13 that the above described etching can be carried out only by using an acidic treatment solution (about 7 volume percent of diluted hydrochloric acid when converted to a concentration of concentrated hydrochloric acid), and combining the cathode electrolysis reduction process and dip process.

The results of the experiments set forth in the present specification show that chromium cannot be stably etched by a diluted hydrochloric acid unless the passivated film of chromium is taken into consideration when etching chromium by diluted hydrochloric acid, without production of hexavalent chromium. In

Experiment 2 of the present specification (see Fig. 14), an experiment was carried out according to applicants' present claims, in which an acidic treatment solution was used and the cathode electrolysis reduction process and dip process were combined. It was found that it is possible to etch the chromium film by about 0.7 volume percent (when converted to a concentration of concentrated hydrochloric acid), that is, about 1/70 of Wheatley, of the diluted hydrochloric acid solution, and as shown in Fig. 17, the production of hexavalent chromium is prevented.

Therefore, when following applicants' present claims, in which the cathode electrolysis reduction process and dip process are combined in a reduction treatment solution, a chromium film can be etched stably and uniformly in about 0.7 to 14 volume percent (when converted to a concentration of concentrated hydrochloric acid) of diluted hydrochloric acid. It is clear that the chromium etching method disclosed in Wheatley is thus substantially different from applicants' present claims.

As indicated in the "Second Chemical Treatment Method" of the "DETAILED DESCRIPTION OF THE INVENTION" of the present specification (see page 14, line 20 to page 16, line 20; page 27, line 27 to page 28, line 3; and Fig. 4) which relates to applicants' claim 11, the material 100 to be treated and an electrode plate 22 as a positive electrode are dipped in an acidic treatment solution 28 (about 0.7 volume percent of a diluted hydrochloric acid solution when converted to a concentration of concentrated hydrochloric acid) contained in a vessel 20. The material 100 is used as a cathode and receives an electric current for a predetermined time, so that an electrolysis reduction for a chromium film 120 is carried out in the treatment solution 28, and the material 100 is continuously immersed in the treatment solution 28. By this acid electrolysis treatment, the oxide film (= passivated film), which can be an oxide chromium film formed on the surface of the chromium film 120 is reduced, and the chromium film 120 is etched to a predetermined pattern as shown in Fig. 2F.

As described on page 15, line 19 to page 16, line 8 of the present specification, chromium film 120 formed on the material 110 can be etched into a predetermined pattern by a simple process, i.e., the acid electrolysis treatment, and the production of hexavalent chromium can also be prevented. Additionally, in the second chemical treatment method, two processes of the cathode electrolysis reduction treatment and acid dip treatment in the first chemical treatment method can be performed by one process of the acid electrolysis treatment. The two processes of the cathode electrolysis reduction treatment and acid dip treatment include a washing treatment between these processes, Therefore, the labor of this washing treatment can be saved by performing only the process of the acid electrolysis treatment. Thus, it is clear that applicants' present claims are substantially different from the chromium etching method disclosed in Wheatley.

Hidaka et al. disclose a metal material, and although a Cr alloy is disclosed, there is no necessity to use the alloy for an electrode.

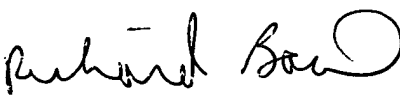
Westbrook discloses only an electroplating bath, and does not have any relevance to applicants' present claims.

The Examiner stated that applicants' claim 8 is disclosed in Wheatley (col. 3, lines 37-39). However, as shown in the enclosed Attachment 3, Wheatley is clearly different from "a portion of the metal film."

It is therefore respectfully submitted that applicants' claimed invention is not anticipated and is not rendered obvious over the references, either singly or combined in the manner relied upon in the Office Action in view of the many distinctions discussed hereinabove. It is furthermore submitted that there are no teachings in the references to combine them in the manner relied upon in the Office Action.

Respectfully submitted,

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Enclosures: (1) PETITION FOR EXTENSION OF TIME
(2) Attachments 1 to 3